



ARSET

Applied Remote Sensing Training

<http://arset.gsfc.nasa.gov>

 @NASAARSET

Advanced Webinar on using NASA Remote Sensing for Flood Monitoring and Management

Instructors:

- Amita Mehta (ARSET)
- Kyle Peterson (ARSET)

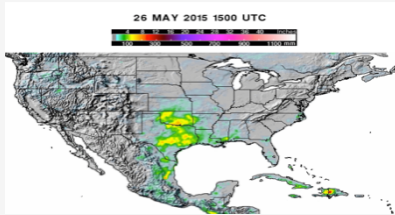
Guest Speaker:

- Sang-Ho Yun (NASA-JPL)

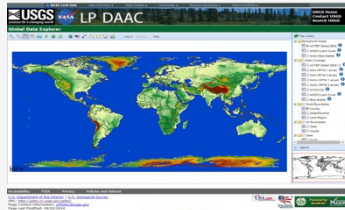
Week-3

Course Outline

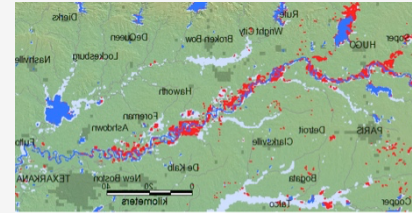
Week 1: Demonstration of Flood Mapping Web Tools Based on NASA Remote Sensing Observations of Rainfall



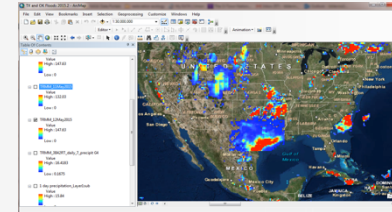
Week 3: Overview & Access to Ancillary NASA Data for Flood Management



Week 2: Demonstration of Flood Mapping Web Tools Based on NASA Remote Sensing Observations of Land Cover



Week 4: Flooding Case Studies Using NASA Web Tools and GIS



Acknowledgements

- **Training Set-up, Coordination, and Website Help**

Tim Sough
Brock Blevins
Elizabeth Hook

- **QGIS Exercise**

Kyle Peterson

Spanish Translation

David Barbato

- **ARSET Manager**


Ana Prados

Course Material

<http://arset.gsfc.nasa.gov/disasters/webinars/advfloodwebinar>

Webinar presentations, exercises, homework assignments, and recordings

Links will be available here




ARSET
Applied Remote Sensing Training

Earth Sciences Division Applied Sciences ASP Water Resources

DISASTERS ECO FORECASTING HEALTH & AIR QUALITY WATER RESOURCES

Disasters
[Disasters Webinars](#)
[Disasters Workshops](#)

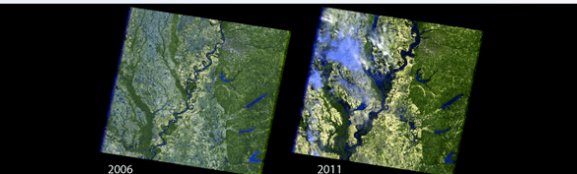
Fundamentals of Remote Sensing
 On-Demand Training on Fundamentals of Remote Sensing

Upcoming Training
Ecoforecasting
[Advanced Webinar: Creating and Using Normalized Difference Vegetation Index \(NDVI\) from Satellite Imagery](#)
02/10/2016 to 03/02/2016

Advanced Webinar on Using NASA Remote Sensing for Flood Monitoring and Management

03/16/2016 to 04/06/2016

Times: 8:00 a.m. - 9:00 a.m. EDT (UTC-4) and 4:00 - 5:00 p.m. EDT (UTC-4)



This webinar will provide demonstrations and hands-on experience in using NASA remote sensing observations and flood mapping tools useful for flood management. Participants will learn to access rainfall, streamflow, and surface inundation extent data for regional flood cases. In addition, participants will learn to access digital elevation and terrain data, as well as socioeconomic data, to facilitate flood risk assessment and post-flood relief planning using a GIS framework.

Course Materials

Date	Title	Materials
March 15, 2016	View Week 1 , Week 2 , and Week 3 of NASA Remote Sensing Observations for Flood Management	Homework - due March 15
March 16, 2016	Demonstration of Flood Mapping Web Tools Based on NASA Remote Sensing Observations of Rainfall	Recording Slides Homework
March 23, 2016	Demonstration of Flood Mapping Web Tools Based on NASA Remote Sensing Observations of Land Cover	Recording Slides Homework
March 30, 2016	Overview and Access to Ancillary NASA Data for Flood Management	Recording Slides Homework
April 6, 2016	Flooding Case Studies Using NASA Web Tools and GIS	Recording Slides Homework

Homework and Certificate

- **Homework**

- Hands-on exercises
- Answers to homework questions via Google form
- Available at <http://arset.gsfc.nasa.gov/disasters/webinars/advfloodwebinar>

- **Certificate of Completion**

- Attend all 4 webinar sessions
- Complete all 4 homework assignments
- Certificates will be emailed approx. 2 months after the course finishes by Marines Martins (marines.martins@ssaihq.com)

Agenda: Week 3

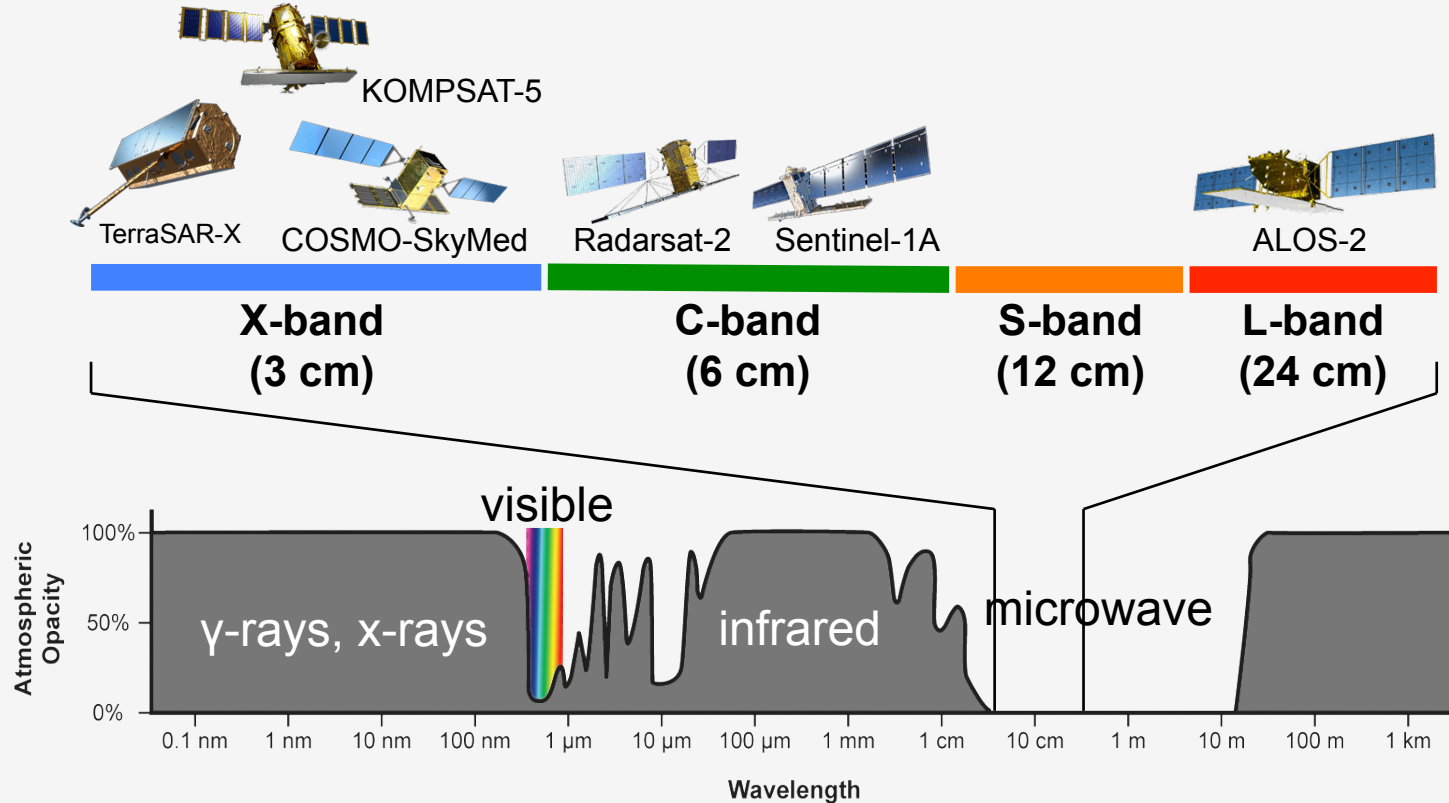
- Synthetic Aperture Radar data and application for flood monitoring
- Overview and Demonstration of Data Access and import into QGIS:
 - Shuttle Radar Topography Mission terrain data access relevant for flood plain identification
 - NASA Socio-economics data access useful for flood preparedness and relief planning



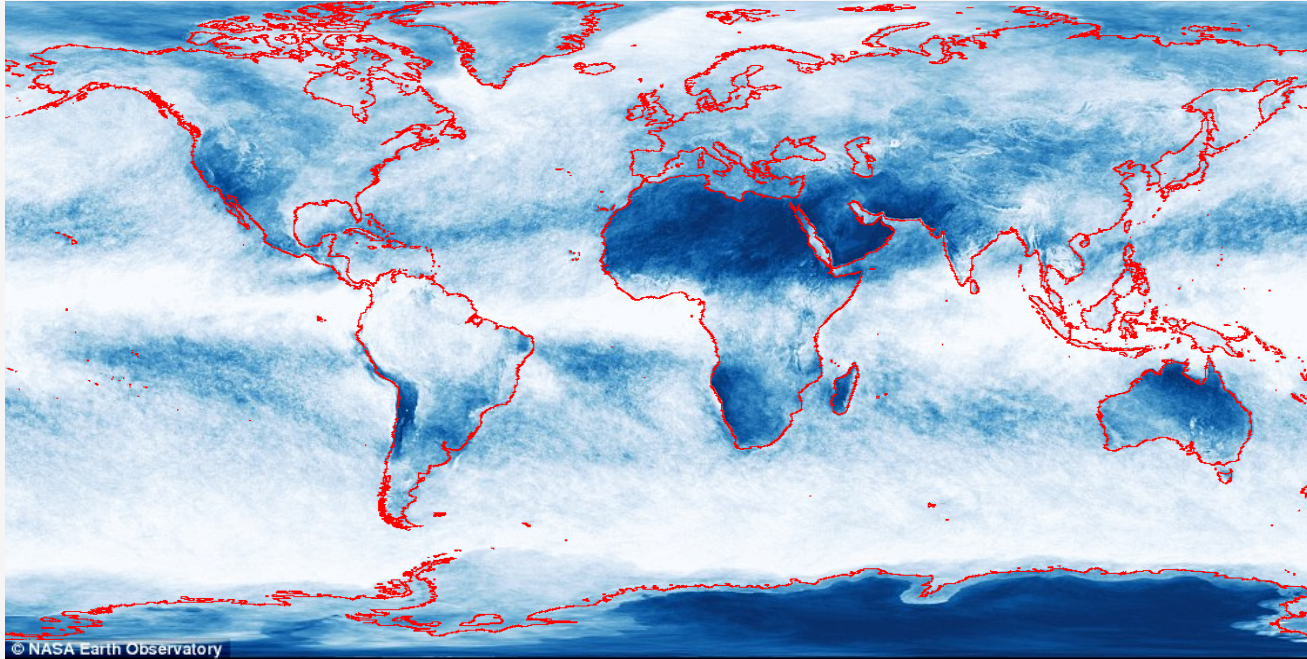
Synthetic Aperture Radar for Rapid Flood Extent Mapping

Sang-Ho Yun
ARIA Team
Jet Propulsion Laboratory
California Institute of Technology

Atmospheric Windows & Current SAR Missions

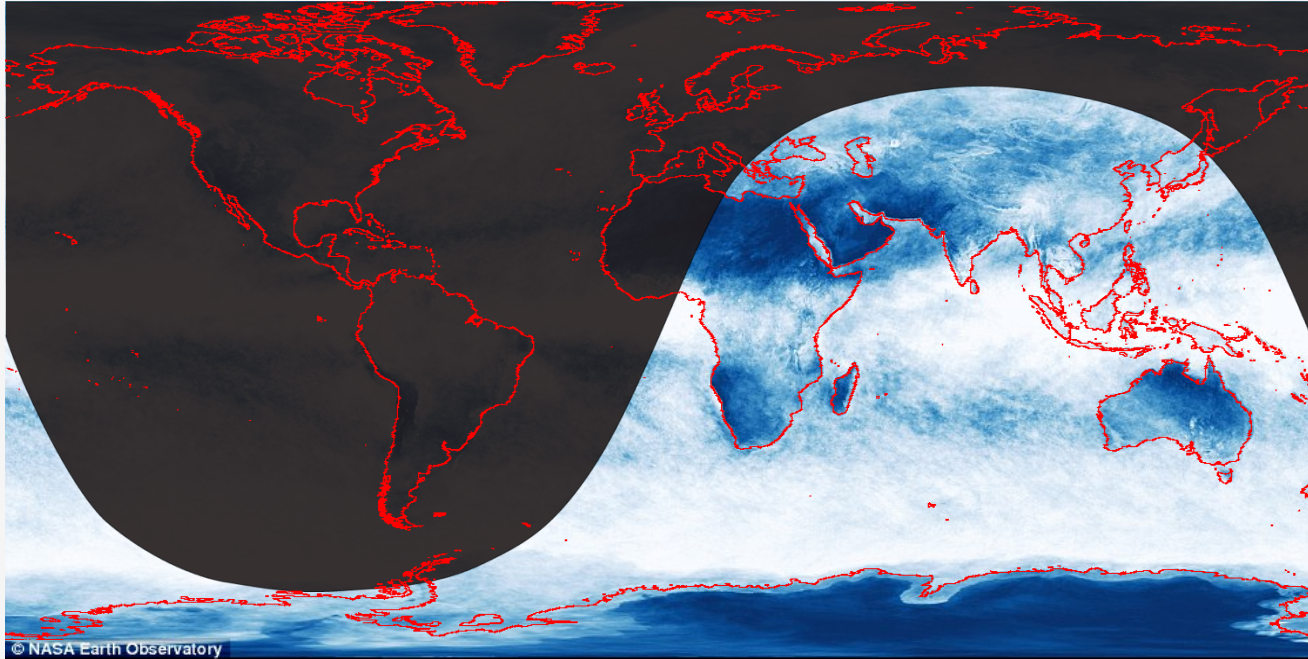


Earth is Mostly Cloudy



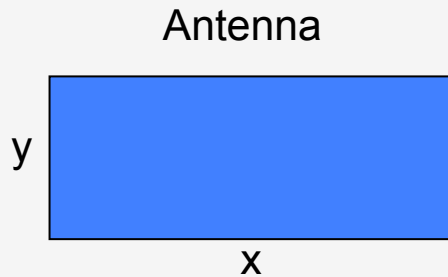
Average cloudiness over Earth in April 2015 seen from Aqua Satellite. At any given time, around 70% of the Earth is covered by clouds.

And Half Dark

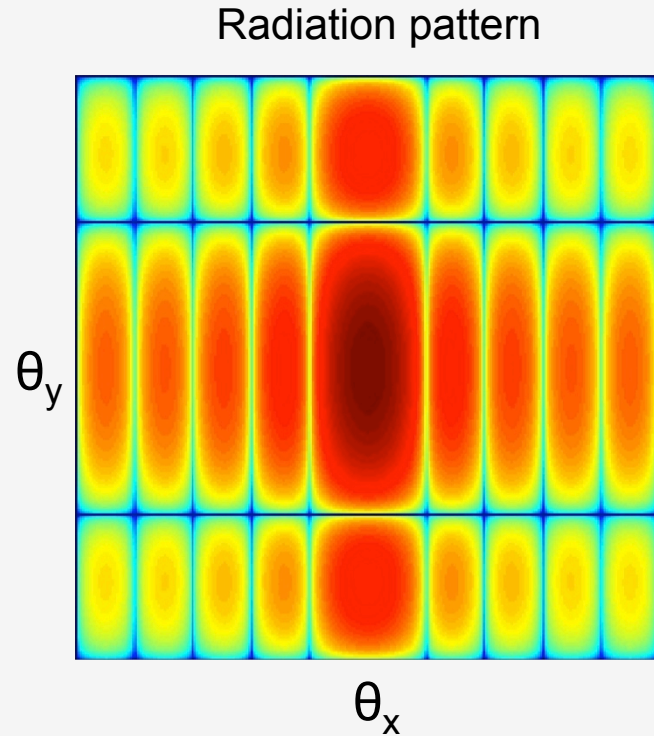


At any given time, 50% of the earth is dark.

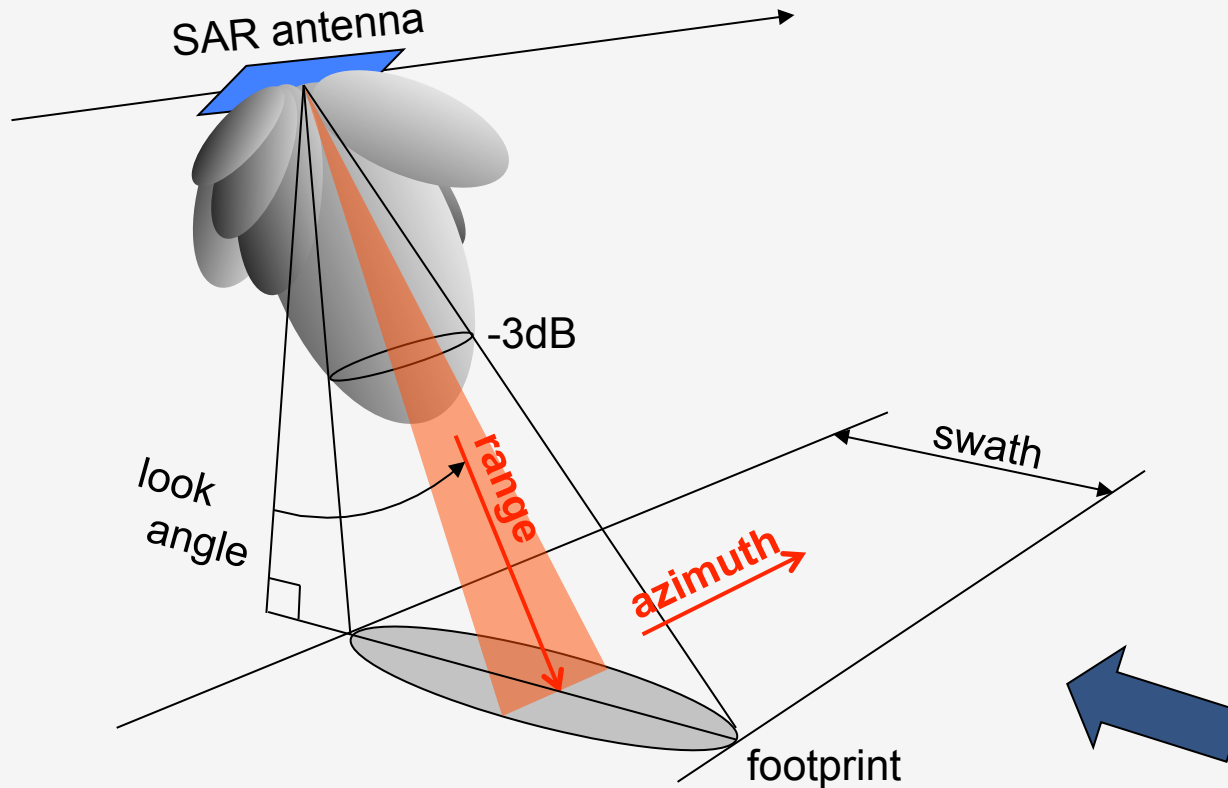
Radiation Pattern



\supset

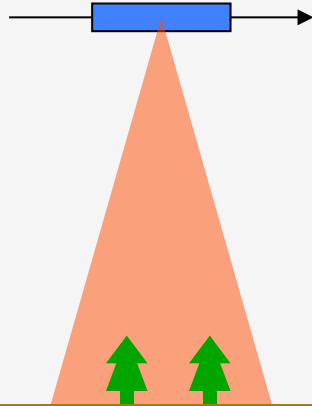


Some Imaging Radar Jargon

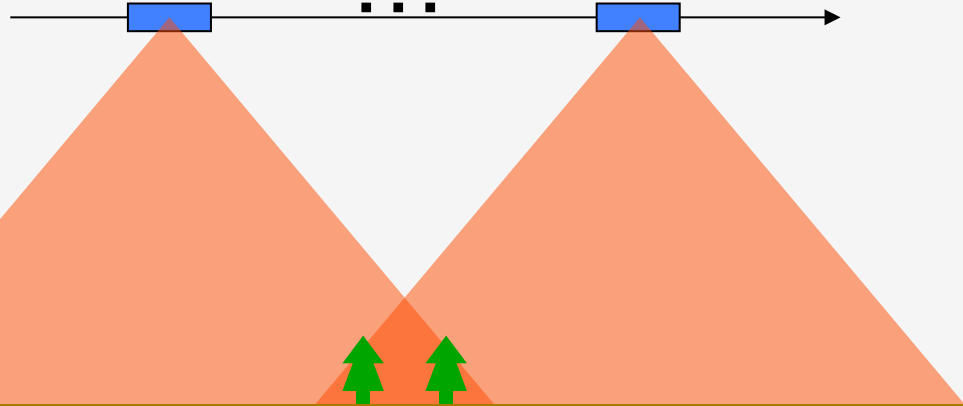


Synthetic Aperture Radar (SAR)

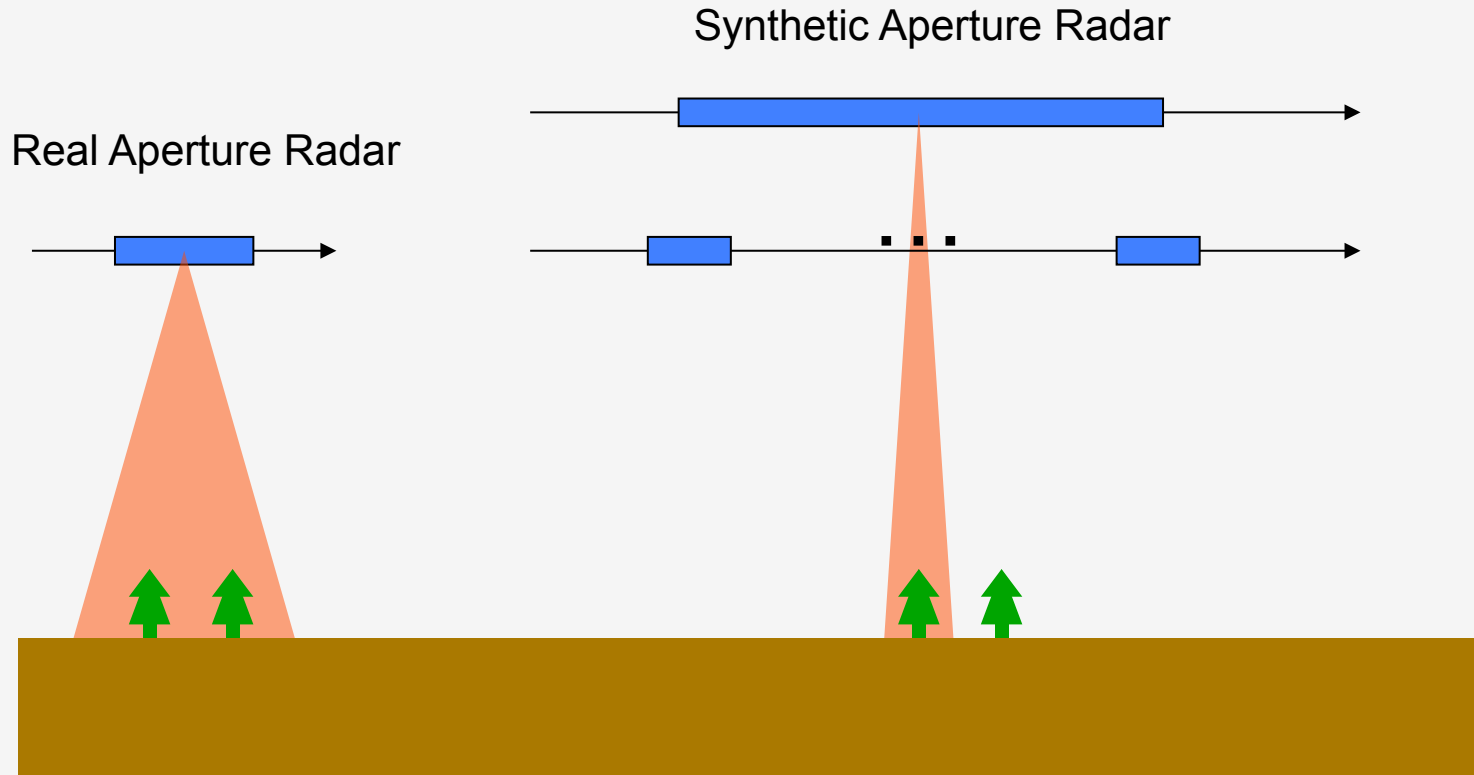
Real Aperture Radar



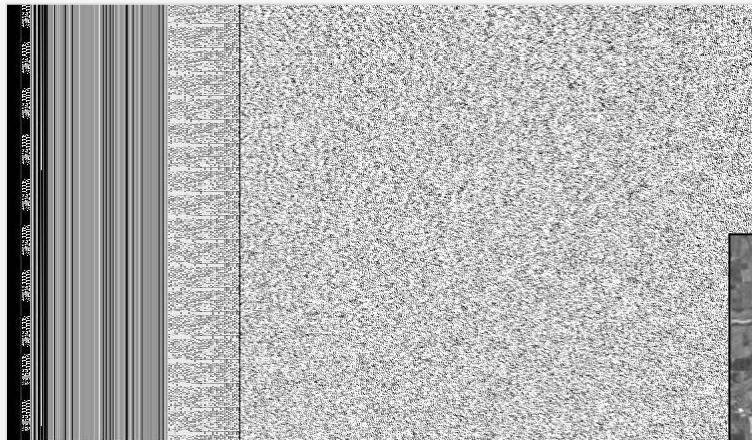
Synthetic Aperture Radar



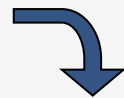
Synthetic Aperture Radar (SAR)



SAR image (amplitude)



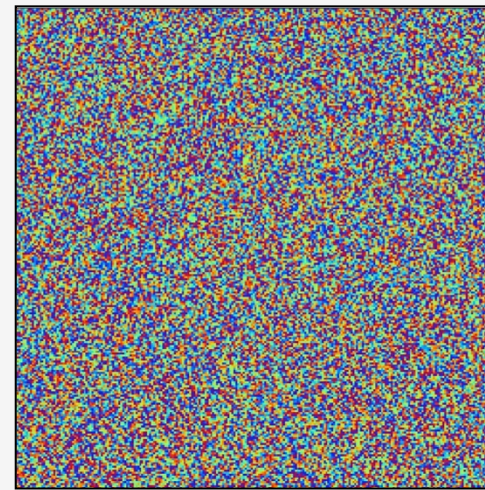
Raw data (complex)



SAR processing

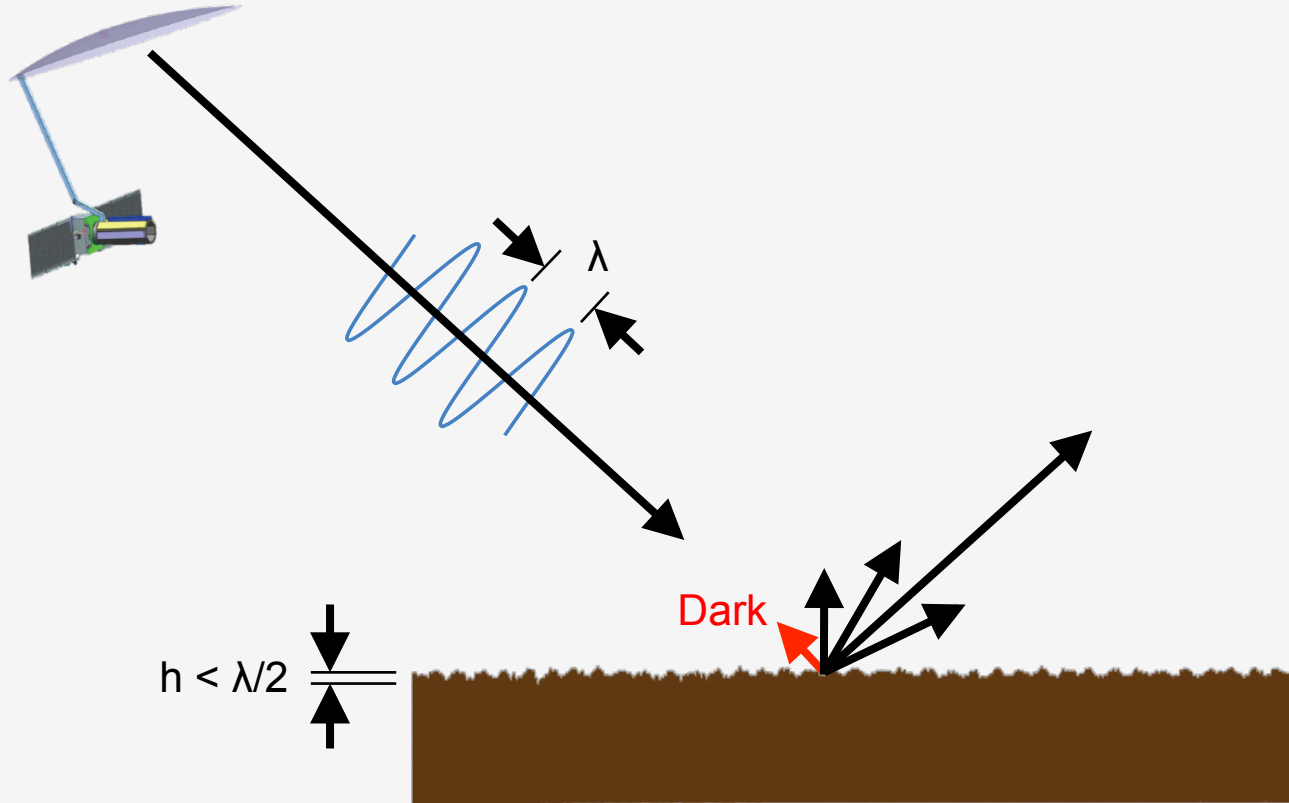


Amplitude

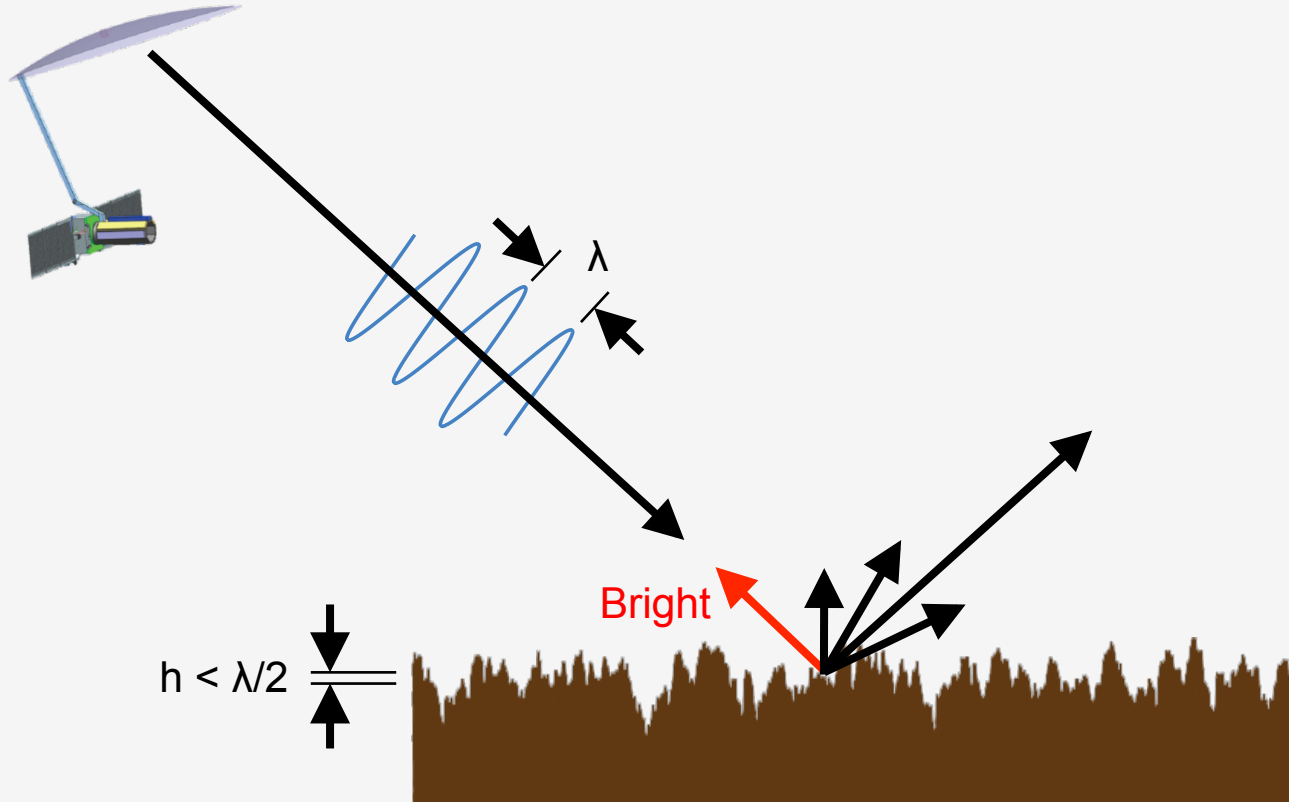


Phase

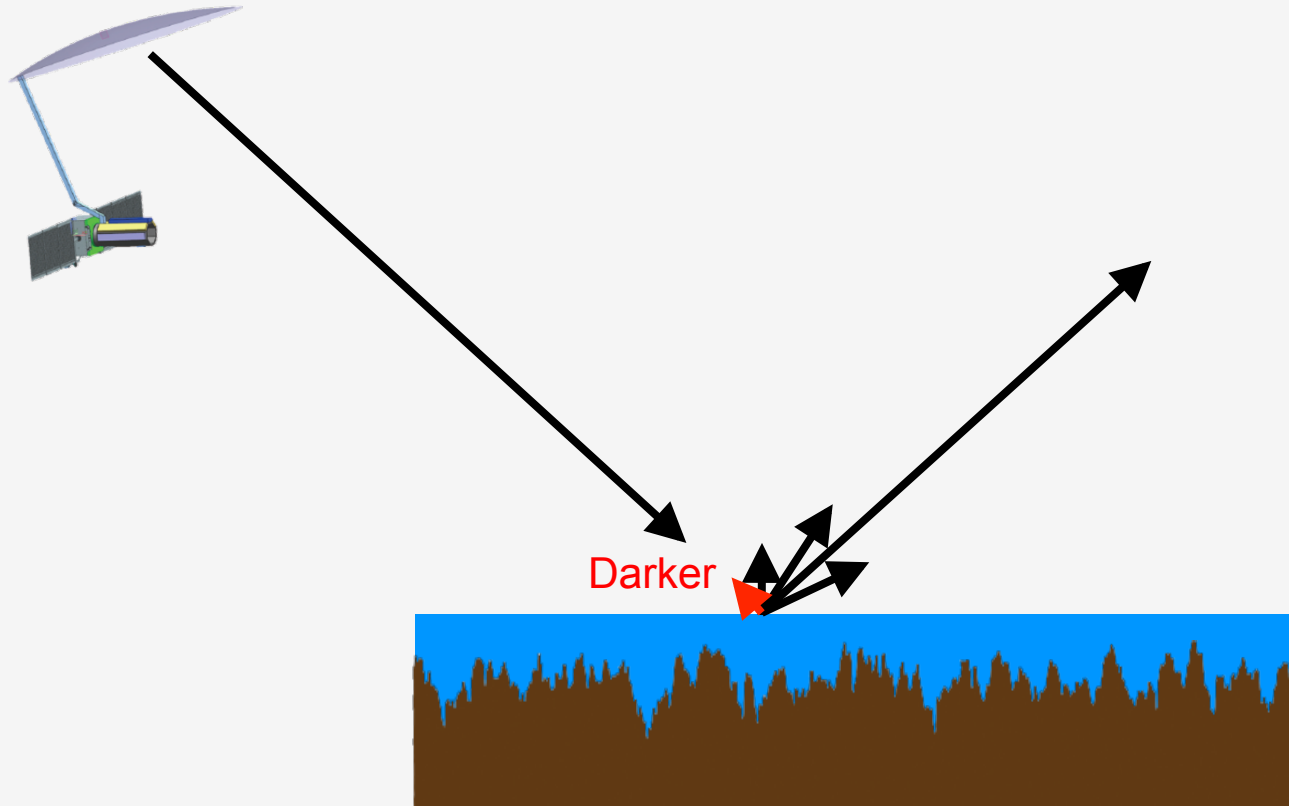
Microwave Scattering (Smooth)



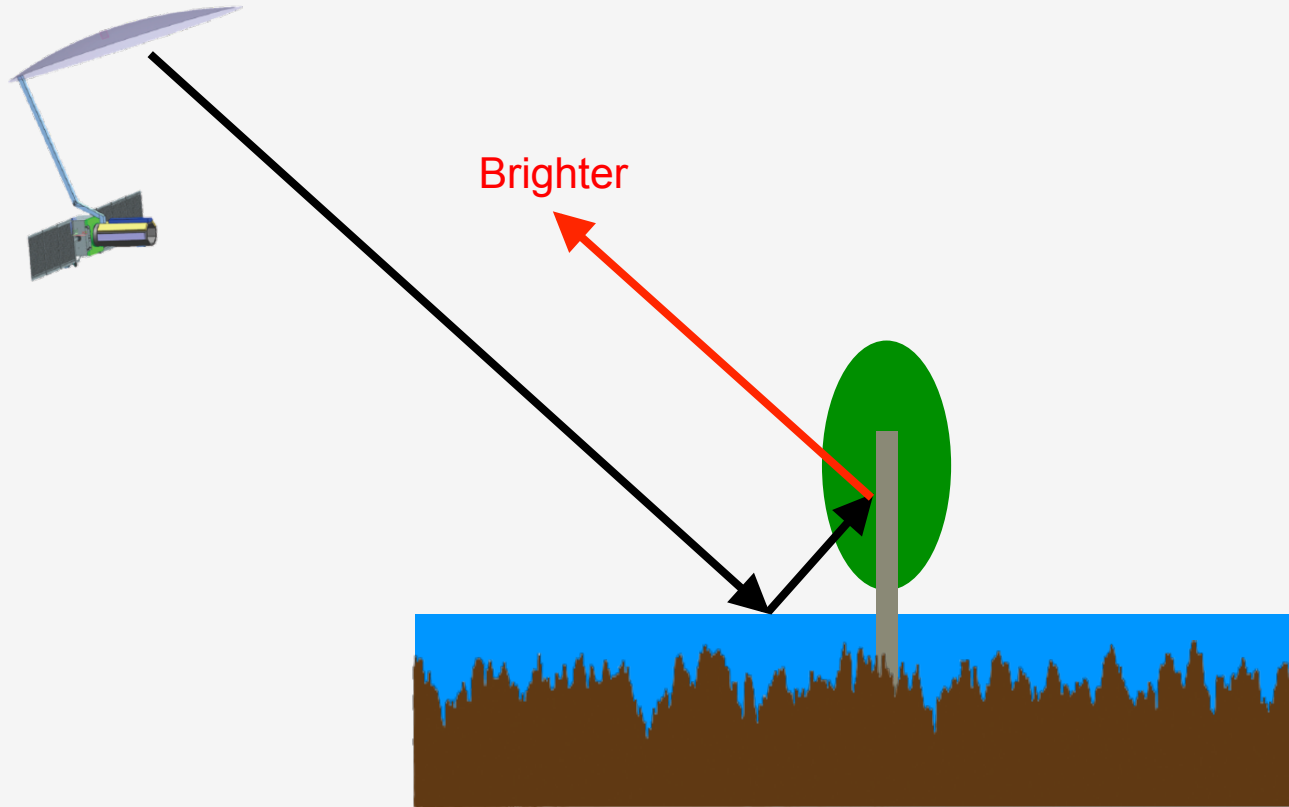
Microwave Scattering (Rough)



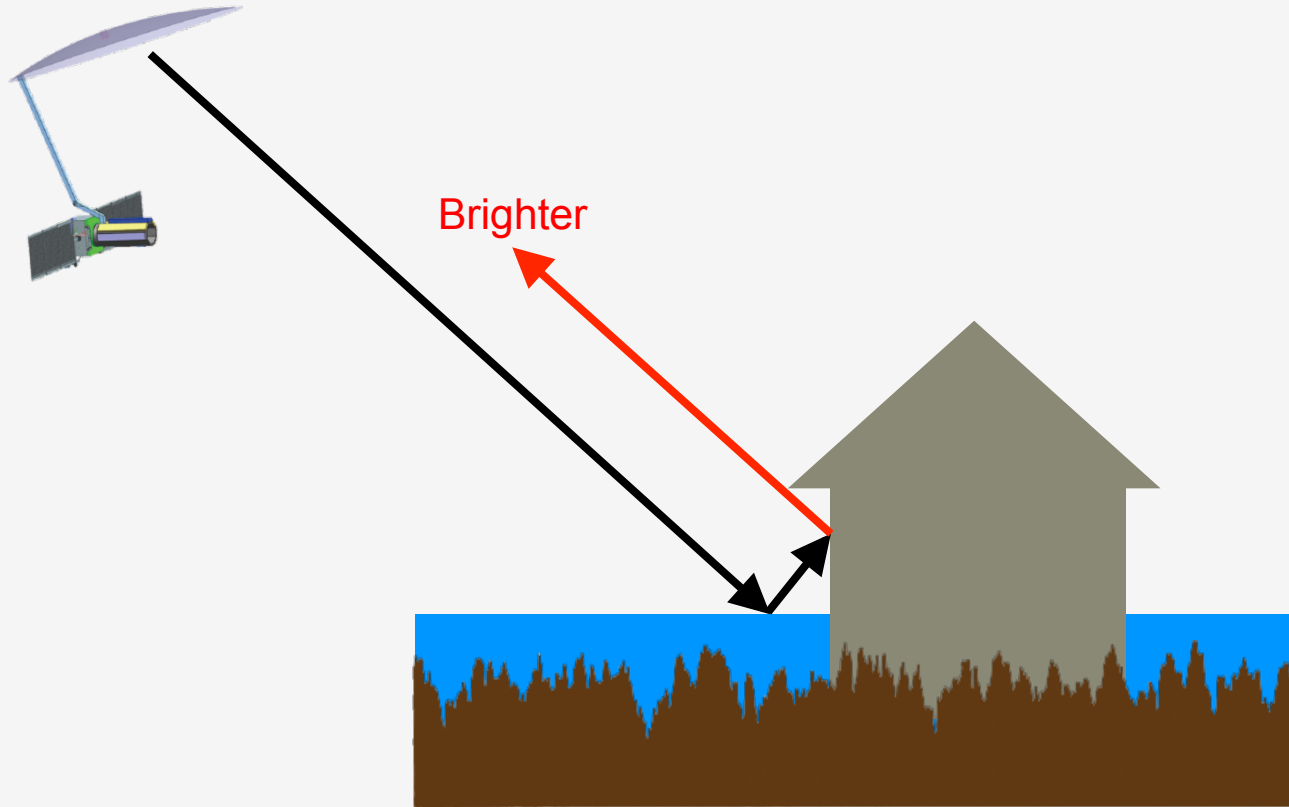
Floods Form Smooth Surface



Floods with Tall Vegetation

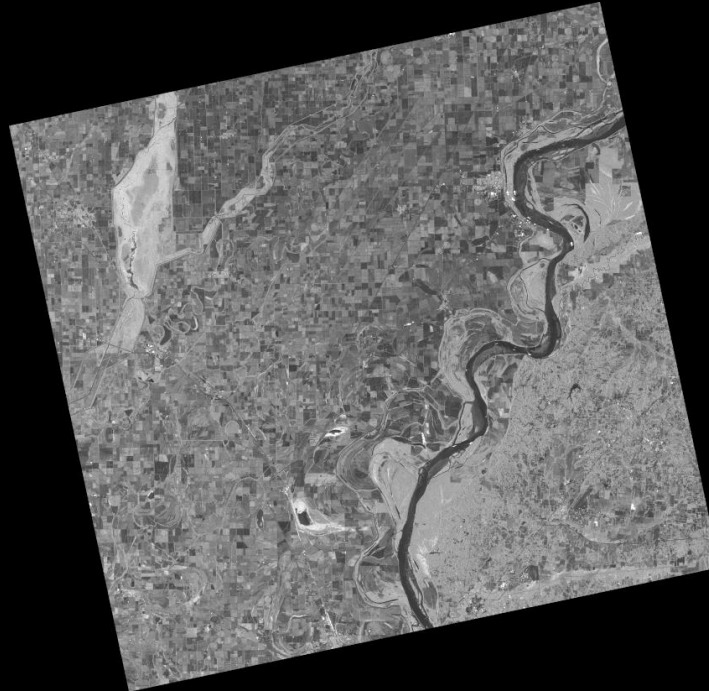


Floods with Artificial Structure



SAR Image (Before)

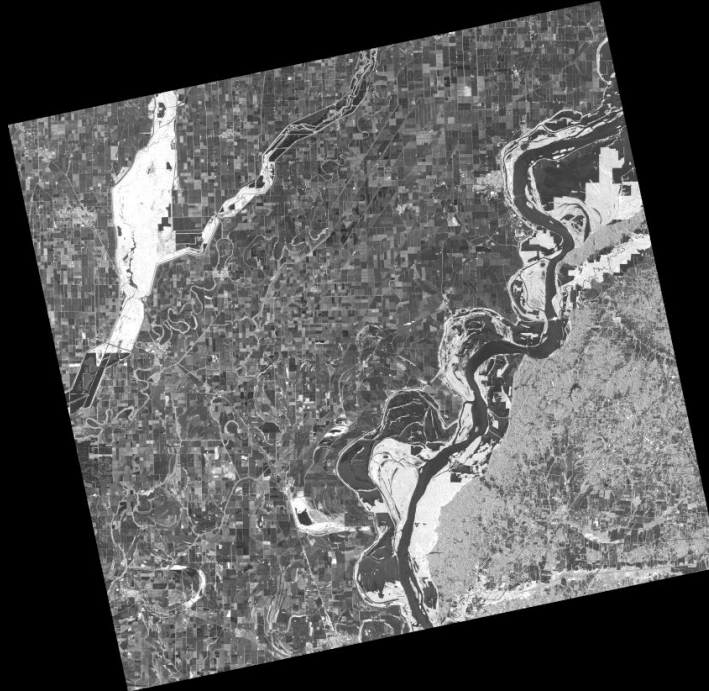
ALOS-2
2015-09-30



©ALOS-2 Operation and Data
Distribution Consortium, Original Data
provided by JAXA

SAR Image (After)

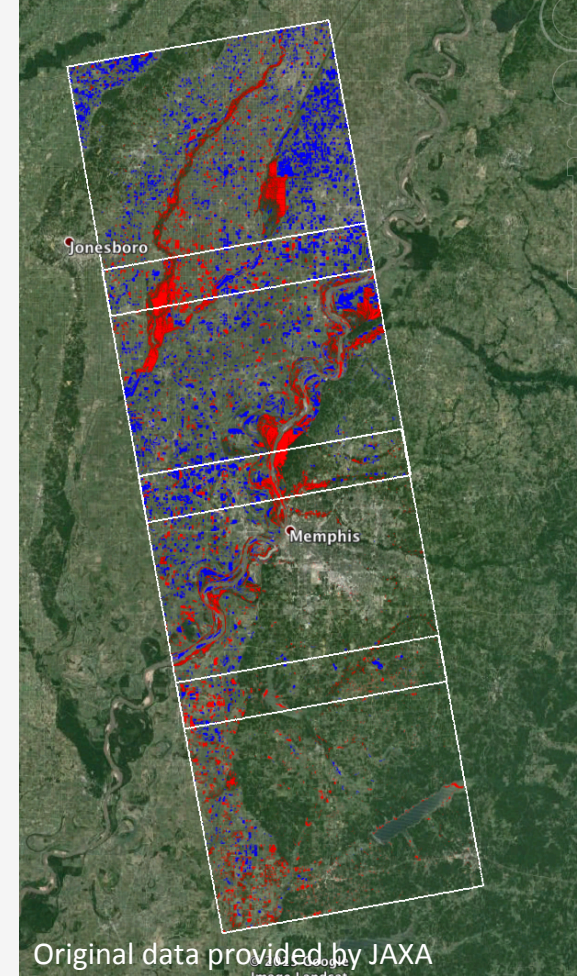
ALOS-2
2016-01-06



©ALOS-2 Operation and Data
Distribution Consortium, Original Data
provided by JAXA

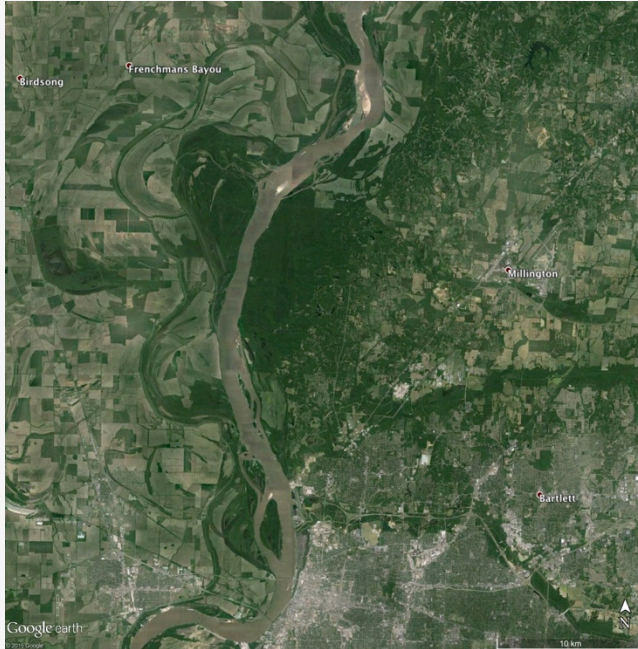
Flood Extent Maps

- Derived from ALOS-2 SAR Data
- 2016-01-06 data compared to 2015-09-30
- Processing Level: 1.5
- Coverage: 70 km x 240 km
- Resolution: ~12 m
- Area of potential floods: Blue + Red
- Blue polygons: Floods with smooth surface
- Red polygons: Floods with tall vegetation
- Product formats
 - KMZ (Polygons)
 - KMZ (PNG image)
 - GeoTiff
 - Shapefile
- Available to download at http://aria-share.jpl.nasa.gov/events/20160111-US_Midwest_Floods/

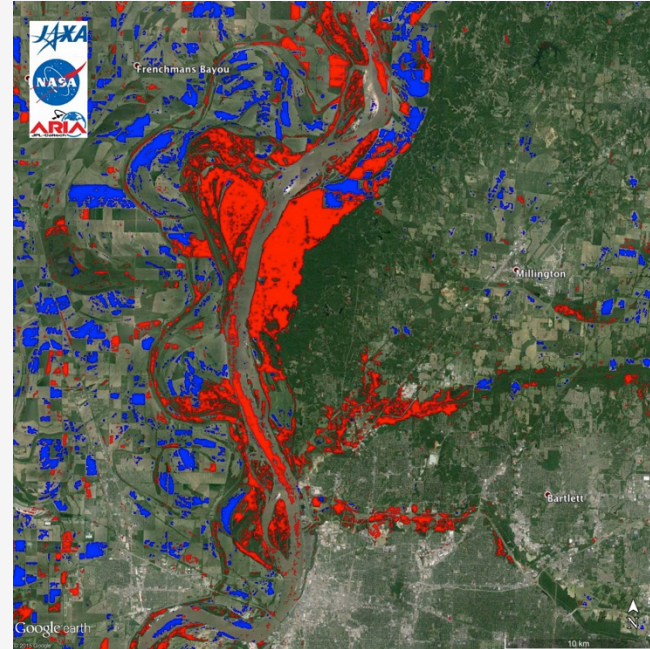


Flood Extent Map

Google Earth

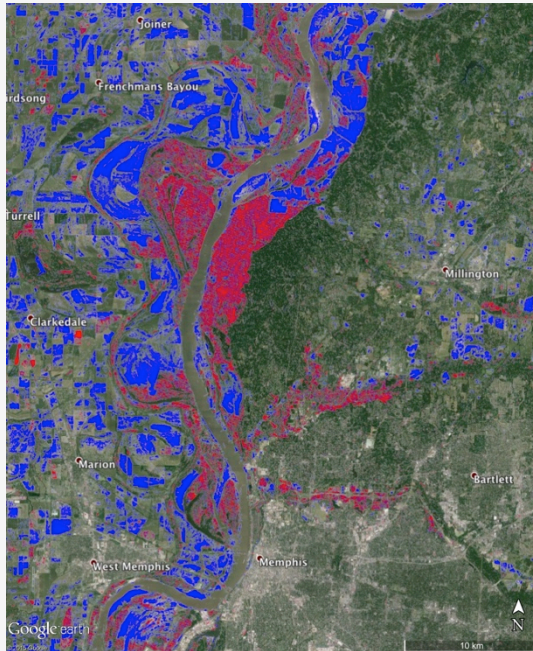


NASA Flood Map

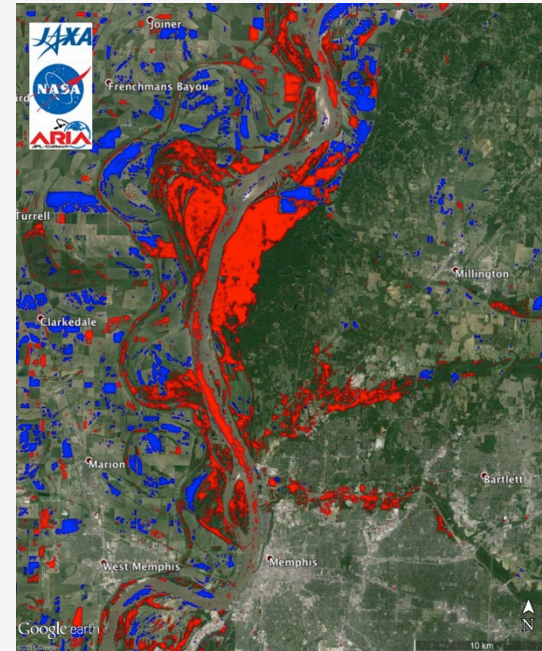


Flood Extent Map

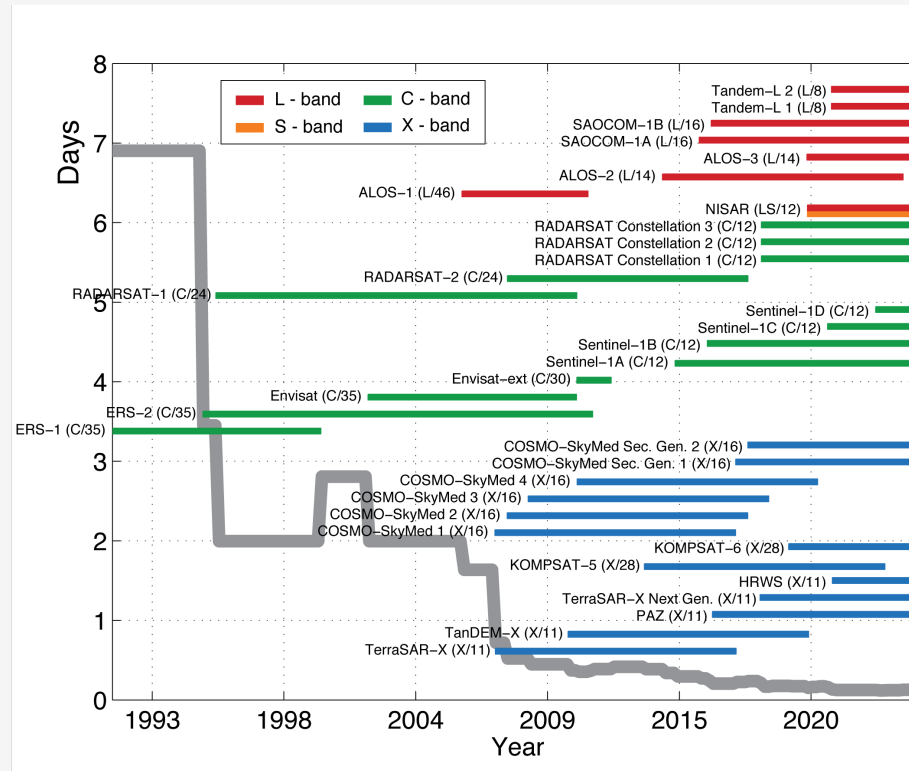
JAXA Flood Map



NASA Flood Map



SAR Data Acquisition Latency



Summary

- Radar sensors see through clouds day and night.
- Synthetic Aperture Radar achieves high resolution (3 – 20 m) over a wide swath (50 – 250 km).
- SAR amplitude is sensitive to floods, with pixel values becoming either darker or brighter.
- Achievable SAR data acquisition latency is already less than a day

Copyright 2016 California Institute of Technology. Government sponsorship acknowledged.

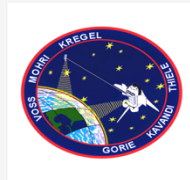
A satellite map of the Southeastern United States, showing parts of Virginia, North Carolina, South Carolina, and Georgia. The map is overlaid with a semi-transparent white rectangle containing text. The background shows a mix of green forest, brown fields, and blue water bodies. Labels for various locations are visible, including Longview, Steeleport, Ruston, Monroe, Vicksburg, Jackson, Raleigh, Fayetteville, Henderson, Alexandria, Natchez, McCamie, Hartsburg, Lake Park, New Orleans, Thibodaux, Beaumont, Houston, and Conroe.

Shuttle Radar Topography Mission (SRTM)

Courtesy: Cynthia Schmidt (NASA-ARSET)
Lindsey Harriman (USGS), Kelly Lemig (USGS)

What is SRTM?

- A Radar mission, carried by NASA Space Shuttle Endeavour, Was completed in February 2000
- Consisted of 176 orbits around Earth in 11 days
- Acquired Digital Elevation Model (DEM) of all land between 60°N and 56°S latitude, about 80% of Earth's total land mass



Useful for Mapping

Hazardous terrain

Calculating

Slope and aspect

Catchment area

Forest canopy height

Modeling

Runoff

Stream networks

Landslides

SRTM v3 Data Product

Tile size	1° by 1°	<div>New version released in 2014 has high resolution</div>
Pixel size	1 arc second (~30 meters) or 3 arc seconds (~90 meters)	
Geographic coordinates	Geographic latitude and longitude	
Output format	DEMS: .HGT, 16-bit signed integer, in units of vertical meters Number: .NUM	
Geoid reference	WGS84/EGM96	
Special DN values	N/A - No voids in v3	
Coverage	60°N to 56°S latitude U.S. and Territories Africa	

How to Access SRTM v3 Terrain data

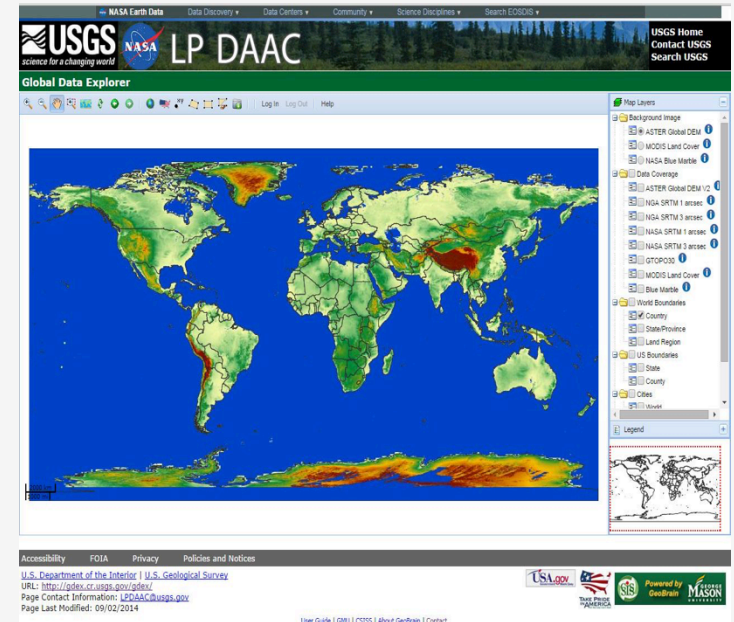
- Reverb:
<http://reverb.echo.nasa.gov/reverb>
- GDEx:
<http://gdex.cr.usgs.gov/gdex/>
- CGIAR-CSI
<http://srtm.csi.cgiar.org>
- Data Pool and DAAC2Disk: https://lpdaac.usgs.gov/data_access/data_pool
- More information: SRTM v3 User Guide
https://lpdaac.usgs.gov/sites/default/files/public/measures/docs/NASA_SRTM_V3.pdf

Interactive Data Access Tools

GDEx

<http://gdex.cr.usgs.gov/gdex/>

- A seamless data viewer providing access to multiple sources of digital elevation data sets
 - Users can subset and download data by area of interest in multiple formats and projections
 - NASA ECHO/Reverb user account required to download data
 - Product documentation and User Guide
 - Square or polygonal area of interest
 - Pre-defined areas of interest (state, county)
 - A dvanced, on-the-fly processing
 - Mosaic tiles coverage clipped to area of interest
 - Reformat to GeoTIFF, ArcASCII, or JPEG
- universal transverse Mercator (UTM) or LAT/LON projection

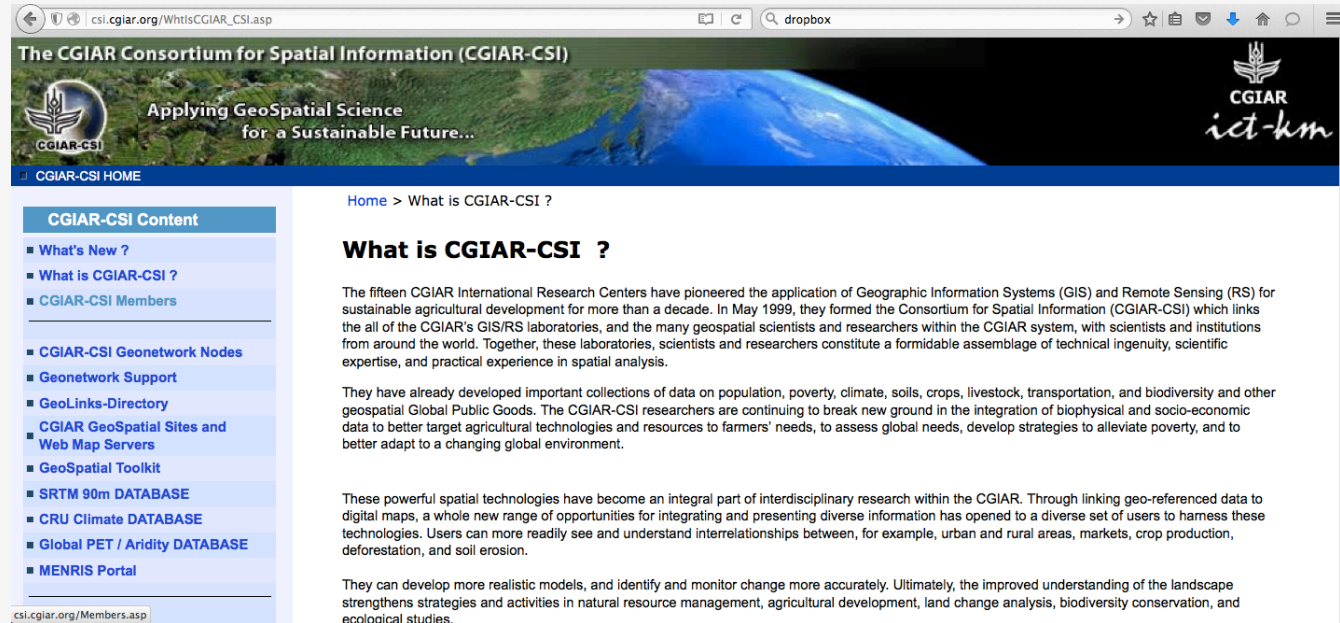


Data can be previewed before download

CGIAR-CSI

http://csi.cgiar.org/WhltsCGIAR_CSI.asp

Consultative Group for International Agricultural Research/Consortium of Spatial Information



The CGIAR Consortium for Spatial Information (CGIAR-CSI)

Applying GeoSpatial Science for a Sustainable Future...

CGIAR-CSI HOME

Home > What is CGIAR-CSI ?

What is CGIAR-CSI ?

The fifteen CGIAR International Research Centers have pioneered the application of Geographic Information Systems (GIS) and Remote Sensing (RS) for sustainable agricultural development for more than a decade. In May 1999, they formed the Consortium for Spatial Information (CGIAR-CSI) which links the all of the CGIAR's GIS/RS laboratories, and the many geospatial scientists and researchers within the CGIAR system, with scientists and institutions from around the world. Together, these laboratories, scientists and researchers constitute a formidable assemblage of technical ingenuity, scientific expertise, and practical experience in spatial analysis.

They have already developed important collections of data on population, poverty, climate, soils, crops, livestock, transportation, and biodiversity and other geospatial Global Public Goods. The CGIAR-CSI researchers are continuing to break new ground in the integration of biophysical and socio-economic data to better target agricultural technologies and resources to farmers' needs, to assess global needs, develop strategies to alleviate poverty, and to better adapt to a changing global environment.

These powerful spatial technologies have become an integral part of interdisciplinary research within the CGIAR. Through linking geo-referenced data to digital maps, a whole new range of opportunities for integrating and presenting diverse information has opened to a diverse set of users to harness these technologies. Users can more readily see and understand interrelationships between, for example, urban and rural areas, markets, crop production, deforestation, and soil erosion.

They can develop more realistic models, and identify and monitor change more accurately. Ultimately, the improved understanding of the landscape strengthens strategies and activities in natural resource management, agricultural development, land change analysis, biodiversity conservation, and ecological studies.

csi.cgiar.org/Members.asp

SRTM Data



A satellite image of Louisiana and surrounding regions, including parts of Texas, Mississippi, and Alabama. A semi-transparent white rectangular box is centered over the state of Louisiana. Inside this box, the title 'Overview of NASA Socioeconomic Data' is written in a large, black, sans-serif font. Below the title is a horizontal line, and then the URL 'http://sedac.ciesin.columbia.edu/' is displayed in a smaller, blue, sans-serif font. The background image shows various geographical features like rivers, lakes, and urban areas, with some place names labeled in small white text.

Overview of NASA Socioeconomic Data

<http://sedac.ciesin.columbia.edu/>

Socioeconomic Data and Applications Center (SEDAC)

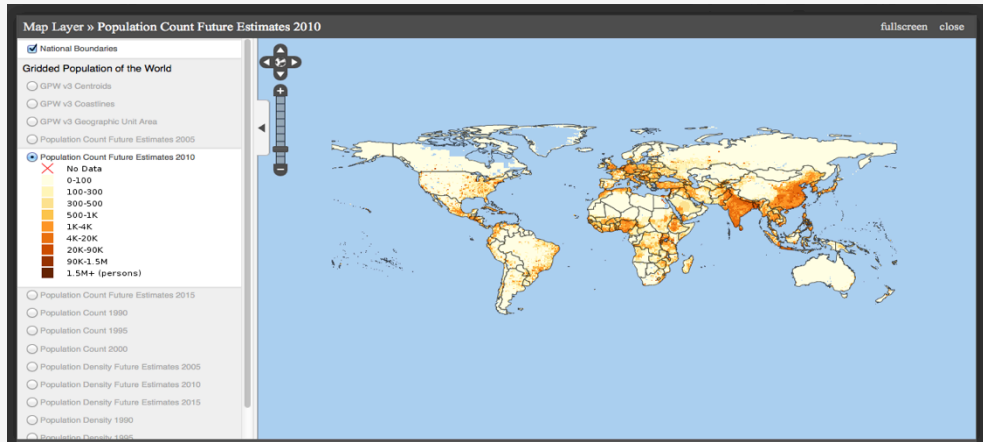
<http://sedac.ciesin.columbia.edu/>



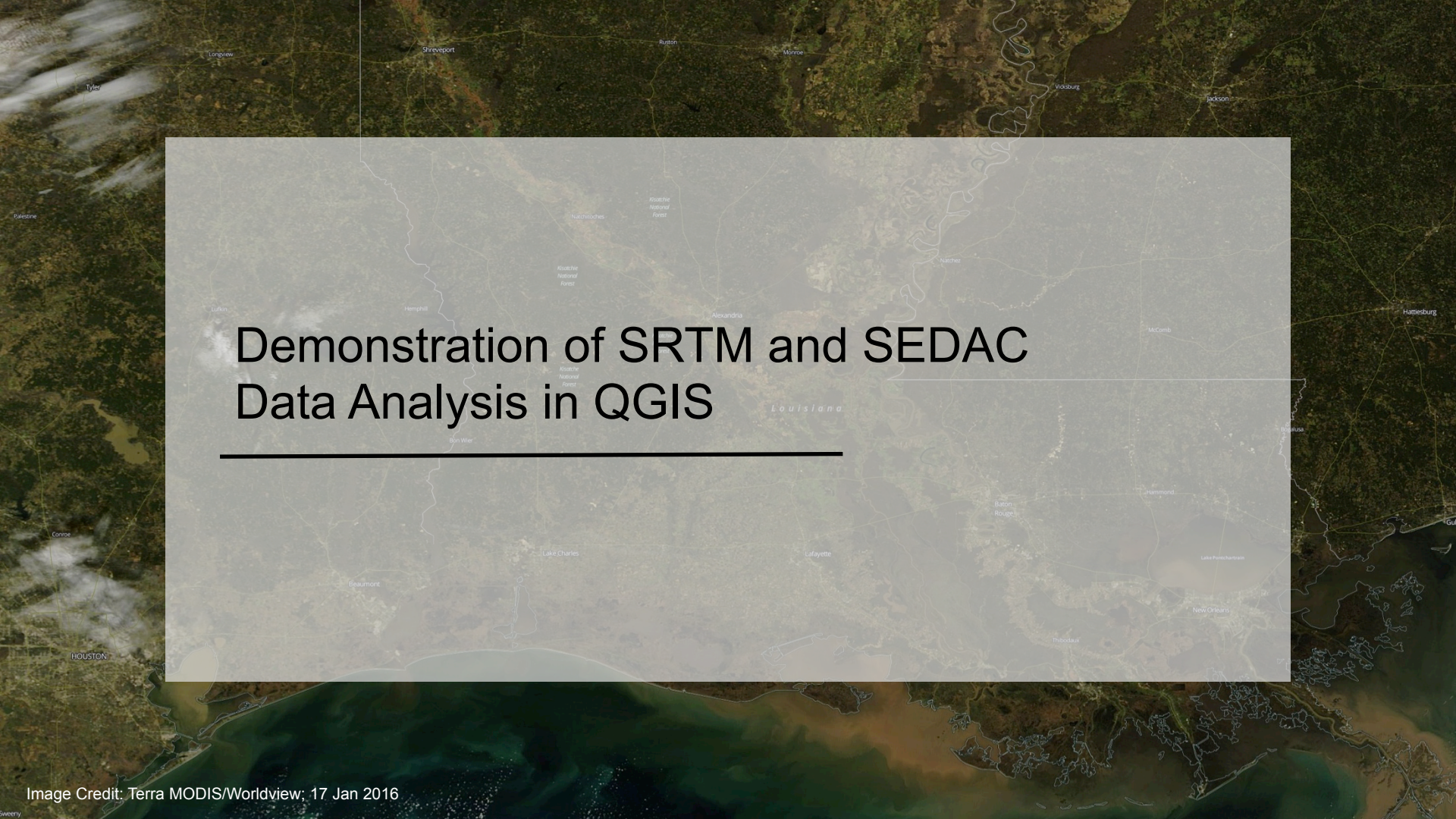
- User registration required
- There are 196 data sets from 16 thematic areas
- Information and documents about the data sets available on-line
- Multiple options for data formats and download
- Interactive mapping and visualization possible

Socioeconomic Data and Applications Center (SEDAC)

<http://sedac.ciesin.columbia.edu/>



- A number of socioeconomic data available that be used along with the flood monitoring tools to facilitate the post-flooding rescue and recovery phases such as:
- Global Urban Areas and Population Density
- Global Roads and Dams
- Nuclear Power Plant Locations and Population Exposure Estimates in the Proximity

A satellite image of the Gulf of Mexico coastline, showing land and water. A semi-transparent white rectangular box is overlaid on the image, containing the title text. The text is in a large, black, sans-serif font. Below the title, there is a horizontal line. The background image shows various geographical features, including rivers, lakes, and coastal areas. Labels for various locations are visible, such as Tyler, Longview, Shreveport, Ruston, Monroe, Vidalia, Jackson, Racine, Lufkin, Hemphill, Alexandria, Natchez, Hammond, Lake Charles, Lake Portchartrain, New Orleans, Thibodaux, Lafayette, Beaumont, and Houston. The word 'Louisiana' is also visible in the center of the map.

Demonstration of SRTM and SEDAC Data Analysis in QGIS

Coming Up Next Week

Flooding Case Studies

- Flood Monitoring and Mapping Using GFMS, ERDS, MODIS NRT, DFO
- Using SRTM and SEDAC data for Flood Management and Relief Planning
 - Mississippi Flooding January 2016
 - India Flooding November 2015
- Course Summary

Thank You

The recording of today's session will be available shortly at
<http://arset.gsfc.nasa.gov/disasters/webinars/advfloodwebinar>